

Hydrogen, Fuel Cells and Infrastructure Technologies Program

Vision for a Secure Energy Future



Powering the Nation

Increasing demand for gasoline and diesel makes our nation more dependent on foreign sources of oil. As consumption outpaces production, this dependence endangers our economy and standard of living, as well as compromising our national energy security.

In his 2003 State of the Union address, President Bush launched the Hydrogen Fuel Initiative to accelerate development of hydrogen and fuel cell technologies. These technologies will not only strengthen our energy security by reducing dependence on imported oil, but also benefit the environment by reducing greenhouse gases and other emissions that affect our air quality.

Hydrogen is an energy carrier; it stores and delivers energy. Hydrogen can be produced using domestic resources, including renewable, fossil and nuclear energy. When used in a fuel cell, hydrogen can generate electricity – with only water and heat as byproducts – to power vehicles, buildings and even small portable equipment. In addition to being pollution-free, hydrogen fuel cells can be more than twice as efficient as conventional gasoline internal combustion engines.

In support of the President's Hydrogen Fuel Initiative, the U.S. Department of Energy's (DOE) Hydrogen, Fuel Cells and Infrastructure Technologies Program works to develop and advance fuel cell and hydrogen production, delivery and storage technologies. As part of the overarching DOE Hydrogen Program (which also includes the DOE Offices of Fossil Energy, Nuclear Energy and Science), the Program works with partners in industry, academia and at national laboratories to overcome technical barriers, address safety concerns, develop model codes and standards and educate the people who will help this technology succeed in the marketplace.

Areas for Research

The Program supports research and development (R&D) to overcome technology barriers to hydrogen fuel cell commercialization:

- **Hydrogen production and delivery.** The greatest technical challenge to hydrogen production and delivery is reducing cost. Hydrogen is produced, delivered and used today, but not in

ways appropriate or at costs low enough for widespread use in transportation. The Program's hydrogen production R&D efforts focus on technologies that can enable the introduction and long-term viability of hydrogen as an energy carrier. This includes distributed production from natural gas, separation and purification technologies, production from renewable liquid fuels such as ethanol and bio-oil, and water electrolysis. The Program also supports R&D of longer-term technologies including photobiological and photoelectrochemical, as well as thermochemical production and high-temperature water-splitting using heat sources such as solar or nuclear (in close coordination with the DOE Office of Nuclear Energy). Coal-to-hydrogen production and carbon sequestration are also important technologies included in the DOE portfolio; R&D efforts in these areas are managed by the DOE Office of Fossil Energy.

The Program's hydrogen delivery activities focus on infrastructure analysis and developing lower-cost pipelines and

off-board storage at refueling stations, as well as lower-cost and more efficient liquefaction and more durable and reliable compression technology.



- **Hydrogen storage.** The low volumetric energy density of hydrogen makes storage a challenge. No current hydrogen storage technology enables a hydrogen fuel cell vehicle to travel the desired 300 miles per fill and meet packaging, cost and performance requirements. To meet this critical need, the Program established a “National Hydrogen Storage Project” to support R&D such as advanced high capacity metal hydrides, carbon-based and high surface area sorbents, as well as chemical hydrogen storage and new materials and concepts. Central to the project are three “Centers of Excellence,” involving teams of multiple national laboratory, university and industry partners.
- **Fuel cells.** Reducing cost and improving durability are the two most significant challenges to fuel cell commercialization. As such, the Program supports high-risk R&D that can lead to breakthroughs in fuel cell materials and component designs that lower costs, improve durability and increase reliability. Emphasis is on fuel cell stack components, including



membranes, membrane electrode assemblies, bipolar plates, and advanced catalysts. The Program also supports R&D for stationary fuel processors, balance-of-plant components, and technical analysis.

Technology Validation, Safety, Codes and Standards and Education

Successful commercialization of any new technology requires real-world testing and data collection. The Program’s National Hydrogen Learning Demonstration pairs automobile and energy companies, their suppliers, and the Federal government to demonstrate and validate hydrogen and fuel cell systems in both controlled and real-world operating conditions. The data collected through this 50-50 industry cost-shared project will be used to evaluate progress toward technical targets for fuel cell durability and range, efficiency and hydrogen cost, and it will also provide important lessons learned about community acceptance, safety, permitting and codes and standards issues.

In addition to working to ensure the safety of DOE-supported R&D projects, the Program funds research of hydrogen behavior and properties, and it supports the consensus process to facilitate codes and standards development. Closely tied to the hydrogen safety activity is a coordinated and comprehensive education effort that includes training programs and information for emergency responders, state and local officials and potential end-users, as well as materials for teachers, students and the general public. Through these education activities, the Program is working to foster an understanding of hydrogen and fuel cell systems that is needed to achieve the hydrogen vision.



The Hydrogen Vision

Hydrogen is America’s clean energy choice. Hydrogen is flexible, affordable, safe, domestically produced and used in all sectors of the economy and in all regions of the country.

Realizing this vision of a “hydrogen economy” will require fundamental changes in the way our Nation produces and uses energy. DOE and its partners are spearheading essential R&D to overcome critical technology barriers and achieve a hydrogen economy.



A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.



U.S. Department of Energy

Energy Efficiency and Renewable Energy

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

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